
NATIONAL AERONAUTICS
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NASA-15865 (June 2004)
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DIVISION 15 - MECHANICAL

SECTION 15865

FILTERS

06/04

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SECTION 15865

FILTERS
06/04

NOTE: Delete, revise, or add to the text in this
section to cover project requirements. Notes are
for designer information and will not appear in the
final project specification.

This section covers basic types of filters for use
with air handling equipment.

Specify any required extra media, filters, and
adhesive.

Drawings shall indicate overall physical features,
dimensions, ratings, service requirements, and
equipment weights.

PART 1 GENERAL

1.1 REFERENCES

NOTE: The following references should not be
manually edited except to add new references.
References not used in the text will automatically
be deleted from this section of the project
specification.

The publications listed below form a part of this section to the extent
referenced:

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)

ASHRAE 52.1 (1992) Gravimetric and Dust Spot
Procedures for Testing Air-Cleaning
Devices Used in General Ventilation for
Removing Particulate Matter

ASTM INTERNATIONAL (ASTM)

ASTM A 526/A 526M (1990) Standard Specification for Steel
Sheet, Zinc-Coated (Galvanized) by the
Hot-Dip Process, Commercial Quality

ASTM A 527/A 527M	(1990) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality
ASTM D 92	(2002b) Standard Test Method for Flash and Fire Points by Cleveland Open Cup
ASTM E 84	(2003) Standard Test Method for Surface Burning Characteristics of Building Materials

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST PS 1	(1995) Construction and Industrial Plywood
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U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD 282	(Notice 3) Filter Units, Protective Clothing, Gas-Mask Components, and Related Products: Performance-Test Methods
MS MIL-F-29177	(1985a) Filter, Air-Extended Area, Initial Installation
MS MIL-F-51079	(1998d) Filter Medium, Fire-Resistant, High-Efficiency

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD 209	(Rev C) Clean Room and Work Station Requirements, Controlled Environment
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UNDERWRITERS LABORATORIES (UL)

UL 586	(2000) UL Standard for Safety High-Efficiency Particulate, Air Filter Units
UL 723	(2003) UL Standard for Safety Test for Surface Burning Characteristics of Building Materials
UL 900	(1994; Rev thru Oct 1999) Standard for Safety for Air Filter Units

1.2 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01330 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control. Include a columnar list of appropriate products and tests beneath each submittal description.

The following shall be submitted in accordance with Section 01330 SUBMITTAL

PROCEDURES in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Installation Drawings shall be submitted in accordance with the paragraph entitled, "Holding Frame Installation," of this section.

SD-03 Product Data

Equipment and Performance Data shall be submitted for air filters in accordance with paragraph entitled, "General Requirements," of this section.

Manufacturer's catalog data shall be submitted for the following items:

Air Filters
Filter Gages
Manometers

SD-06 Test Reports

Test Reports shall be submitted for air filters in accordance with paragraph entitled, "Tests," of this section.

SD-07 Certificates

Certificates shall be submitted for the following items showing conformance with the reference standards contained in this section.

Air Filters
Filter Gages
Manometers

1.3 GENERAL REQUIREMENTS

NOTE: If Section 15003 GENERAL MECHANICAL PROVISIONS is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted.

Section 15003 GENERAL MECHANICAL PROVISIONS applies to work specified in this section.

Equipment and Performance Data shall be submitted for air filters consisting of use life, system functional flows, safety features, and mechanical automated details. Curves indicating tested and certified equipment responses and performance characteristics shall also be submitted.

PART 2 PRODUCTS

2.1 FILTERS

Air filters shall have a net effective filtering area and a face area to provide the required airflow at the indicated initial pressure-drop.

Filter assembly shall be suitable for space provided with sufficient clearance for maintenance and operation.

Filter-holding frames shall be constructed of [extruded aluminum] [type 300 corrosion-resistant steel] [corrosion-resistant coated 16-gage 1.6 millimeter (minimum) steel] [not less than 16-gage 1.6 millimeter galvanized carbon steel conforming to ASTM A 527/A 527M with not less than 1.25 ounces of zinc per square foot 0.38 kilogram of zinc per square meter of two-sided surface] [wood-pulp products]. All frame assemblies and fasteners shall be corrosion-resistant metal or carbon steel with a corrosion-resistant finish to preclude surface degradation.

[Viscous-impingement framed panel filter gaskets shall be made from a material inert to filter impregnants. Minimum thickness after compression shall be 1/8 inch 3 millimeter.]

[Dry filter gaskets shall be closed-cell foamed neoprene or urethane elastomer of sufficient hardness to compress to not more than 40 percent of original thickness when filter is in position.]

2.1.1.1 Filters, Disposable Type

Minimum acceptable performance for the air filter shall be as listed below:

<u>DIMENSIONS (INCHES)</u>	<u>INITIAL RESISTANCE (INCH WG)</u>	<u>ARRESTANCE (PERCENT)</u>	<u>DUST-HOLDING CAPACITY (GM/SQ FT)</u>
14 by 20 by 1	0.04	65	145
16 by 20 by 1	0.04	65	145
16 by 25 by 1	0.04	65	145
20 by 20 by 1	0.04	65	145
20 by 25 by 1	0.04	65	145
16 by 20 by 2	0.08	75	190
16 by 25 by 2	0.08	75	190
20 by 20 by 2	0.08	75	190
20 by 25 by 2	0.08	75	190

<u>DIMENSIONS (MILLIMETER)</u>	<u>INITIAL RESISTANCE (pascal)</u>	<u>ARRESTANCE (PERCENT)</u>	<u>DUST-HOLDING CAPACITY (GRAM/SQ FT)</u>
350 by 500 by 25	10	65	1560
400 by 500 by 25	10	65	1560
400 by 650 by 25	10	65	1560
500 by 500 by 25	10	65	1560
500 by 650 by 25	10	65	1560
400 by 500 by 25	20	75	2050
400 by 650 by 50	20	75	2050
500 by 500 by 50	20	75	2050
500 by 650 by 50	20	75	2050

For all sizes of filters, final resistance value shall be 0.50 inch 125 pascal, air volume shall be 1,200 cubic feet per minute 0.6 cubic meter per second, and airflow velocity shall be 300 feet per minute 1.5 meter per second.

2.1.1.2 Filters, Cleanable Type

Filtering element shall be nonwoven synthetic-fabric-type, supported on rigid pleats of suitable grid material. Filter element shall be sealed into an enclosing frame of rigid chipboard, providing a unit that will not rack. Overall depth shall be nominally [2 inches] [4 inches] [50 millimeter] [100 millimeter]. Initial pressure drop at a face velocity of 500 fpm 2.5 meter per second shall be [0.25] [0.22] inch wg [62] [55] pascal.

Average dust-spot efficiency shall be [10 percent] [18 percent] and arrestance shall be [85 percent] [87 percent] when filter is operated to a final pressure drop of 1 inch wg 250 pascal. Under these circumstances, dust-holding capacity shall be [45] [70] grams per square foot [485] [750] grams per square meter of face area.

Test method shall be in accordance with ASHRAE 52.1.

2.1.1.3 Filters, Replaceable Type

Filters shall conform to MS MIL-F-29177, Type I or Type II. Filter efficiency shall be based on ASHRAE 52.1. Efficiency, by definition, is dust-spot efficiency using atmospheric dust. Arrestance is weight efficiency using test dust. Type III filter arrestance efficiencies shall

be in accordance with MIL-STD 282 DOP test.

Each air filter shall consist of a permanent corrosion-resistant holding frame and a replaceable factory-assembled filter element. Permanent holding frame shall be supplied with suitable gaskets and shall be designed to maintain a positive pressure seal between the frame and the filter element(s).

Air filters shall be designed and constructed to facilitate field maintenance. Adjustments and replaceable accessories shall be readily accessible. Conditions which may be hazardous to personnel or deleterious to equipment shall not be permitted.

Filter element shall be nonallergenic and nontoxic, with no detectable odor. Filter element shall have no adverse effect on the health of personnel handling or served by the filter element.

Adhesive coatings used on filters shall have a flashpoint of not less than 325 degrees F 163 degrees C and shall conform to ASTM D 92.

[Filters shall be Type 1, Grade A, 30 percent commercially rated efficiency, and shall conform to UL 900, Class 2, and requirements specified herein. Filters, when operated at rated capacity of [_____] cfm cubic meter per second, shall have an initial pressure drop of not more than [_____] inch wg pascal, and final pressure drop shall not exceed [_____] inch wg pascal. Filter initial efficiency shall be not less than 20 percent, and the average efficiency shall be not less than 25 percent. Dust-holding capacity (grams per square foot meter), at a rated air flow (cubic feet per minute meter per second) shall be not less than [_____] at [_____] [600 at 1,500] [1,000 at 2,000] [1,000 at 2,500] [6460 at 0.7] [10800 at 0.9] [1.2]], respectively.]

[Filter shall be Type I, Grade B, 40 percent commercially rated efficiency, and shall conform to UL 900, Class 2, and requirements specified herein. Filters, when operated at rated capacity of [_____] cfm cubic meter per second, shall have an initial pressure drop of not more than [_____] inch wg pascal and final pressure drop shall not exceed [_____] inch wg pascal. Filter initial efficiency shall be not less than 20 percent, and the average efficiency shall be not less than 35 percent. Dust-holding capacity (grams per square foot meter), at a rated air flow (cubic feet per minute meter per second) shall be not less than [_____] at [_____] [500 at 1,500] [600 at 2,000] [700 at 2,500] [5380 at 0.7] [6460 at 0.9] [7535 at 1.2], respectively.]

[Filter shall be Type II, Grade C, 85 percent commercially rated efficiency [minimum of 58 percent per ASHRAE 52.1 using atmospheric dust], and shall conform to UL 900, [Class 2] [Class 1] and requirements specified herein. Filters, when operated at rated capacity of [_____] cfm cubic meter per second, shall have an initial pressure drop of not more than [_____] inch wg pascal, and final pressure drop shall not exceed [_____] inch wg pascal. Filter initial efficiency shall be not less than 58 percent, and the average efficiency shall be not less than 76 percent. Dust-holding capacity (grams per square foot meter), at a rated air flow (cubic feet per minute meter per second) shall be not less than [_____] at [_____] [300 at 1,500] [400 at 2,000] [470 at 2,500], [3230 at 0.7] [4300 at 0.9] [5060 at 1.2], respectively.]

[Filter shall be Type II, Grade D, 95 percent commercially rated efficiency [minimum of 78 percent per ASHRAE 52.1 using atmospheric dust], and shall

conform to UL 900, [Class 2] [Class 1] and requirements specified herein. Filters, when operated at rated capacity of [_____] cfm cubic meter per second, shall have an initial pressure drop of not more than [_____] inch wg pascal, and final pressure drop shall not exceed [_____] inch wg pascal. Filter initial efficiency shall be not less than 80 percent, and the average efficiency shall be not less than 90 percent. Dust-holding capacity (grams per square foot meter), at a rated air flow (cubic feet per minute meter per second) shall be not less than [_____] at [_____] [220 at 1,500] [300 at 2,000] [380 at 2,500] [2370 at 0.7] [3230 at 0.9] [4090 at 1.2], respectively.]

[Filters shall be Type III, Grade E, 95 percent rated efficiency [DOP test using 0.2-micrometer particles], and shall conform to UL 900, [Class 2] [Class 1] and requirements specified herein. Filter initial pressure drop shall not exceed [1.0 inch wg with face velocity of 325 fpm on 6 inch deep filter] [1.0 inch wg with face velocity of 500 fpm on 12 inch-deep filter] [[_____] inch wg with face velocity of [_____] fpm on [_____] inch-deep filter] [250 pascal with face velocity of 1.7 meter per second on 150 millimeter deep filter] [250 pascal with face velocity of 2.5 meter per second on 300 millimeter deep filter] [[_____] pascal with face velocity of [_____] on [_____] millimeter deep filter], and final pressure drop shall not exceed [2.0 inches wg with face velocity of 325 fpm on 6 inch-deep filter] [2.0 inches wg with face velocity of 500 fpm on 12 inch-deep filter] [[_____] inches wg with face velocity of [_____] fpm on [_____] inch deep filter] [500 pascal with face velocity of 1.7 meter per second on 150 millimeter deep filter] [500 pascal with face velocity of 2.5 meter per second on 300 millimeter deep filter] [[_____] pascal with face velocity of [_____] on [_____] millimeter deep filter]. Filter efficiency shall be not less than 95 percent and shall be determined in accordance with MIL-STD 282, using 0.3-micrometer particle of thermally generated DOP smoke.]

2.1.4 Filters, Automatic Type

Filters shall be of the automatic renewable filtering element type in which a roll of the element is unwound across the airstream by a mechanism regulated by a timer or a differential-pressure control, or a combination of both.

Unit shall be suitable for 120-volt, single-phase, 60-hertz power.

Filter performance data shall be manufacturer-established in accordance with ASHRAE 52.1 dynamic loading test procedures. Initial resistance shall not exceed 0.20 inch wg 5 pascal at an airstream velocity of 500 fpm 2.5 meter per second. Each filter, when operating at its specified rate of airflow, shall have a dust-holding capacity of 65 grams per square foot 700 grams per square meter when the resistance to airflow is maintained between 0.45 and 0.55 inch wg 112 and 137 pascal. Filtering element shall have an average dust-spot efficiency of not less than 20 percent and an arrestance of 85 percent.

Filtering element shall be the viscous-impingement progressively graded density UL, Class 2, fibrous-glass type. Element shall be continuous material with a normal depth of 2 inches 50 millimeter when clean and shall not compress more than 1/4 inch 6 millimeter when subject to air velocity of 500 fpm 2.5 meter per second. Element shall be reinforced in both length and width and supported so that there will be no leakage of unfiltered air.

Dirty element shall be wound with the dirty surface inward and shall be rerolled automatically under tension. Each spool of filtering element shall be provided with guide keys to ensure correct installation. Element

shall have a compressibility that will allow 65 feet 20 meter to be wound to a maximum of 16 inches 400 millimeter in diameter on the used roll. Each roll of filtering element shall be not less than 65 feet 20 meter long.

Clean and dirty filtering element shall be wound and fed so that no blowoff of collected dirt can occur. Otherwise, clean and dirty elements shall be contained in steel enclosures in reverse-flow units and in horizontal units where the element is wound outside of airstream.

Filter widths provided shall be of uniform size for all project air-handling units.

Timer shall be the electrically driven type, readily adjustable in the field without special tools. Timer shall be electrically interlocked with the fan motor to start and stop the filter element advancing mechanism, as required, when the fan is operating. Initial adjustment of the timer shall be such that the pressure-drop through the filter element will be maintained at approximately 0.45 inch wg 112 pascal. If used, the differential-pressure control shall be adjustable to any cut-in and cutout with a differential of from 0.05 to 0.10 inch wg 12 to 25 pascal. Initial adjustments shall be 0.55 inch 137 pascal cut-in to 0.45 inch wg 112 pascal cutout. Controls shall be out of the airstream.

Master section shall be equipped with a runout switch to stop the feed movement and operate a signal light when the element from one of the sections runs out. A manual feed-advance switch shall be furnished with each drive unit to advance the element to the end of the roll as required. Signal light shall be located on the air-handling unit temperature-control panel.

Filter-supporting structural members shall be fabricated of not less than 14-gage 2 millimeter mill-galvanized carbon steel for the base and side panels and 16-gage 1.6 millimeter mill-galvanized carbon steel for the top panel. Galvanized steel sheet shall be in accordance with ASTM A 526/A 526M.

2.1.5 Filters, High-Efficiency Particulate Air (HEPA)

HEPA filters shall be fire-resistant type and shall be capable of withstanding a minimum of 90-percent relative humidity determined dynamically at temperatures between 70 and 100 degrees F 21 and 38 degrees C.

Filtering element shall conform to MS MIL-F-51079. Filter shall be individually certified to have an efficiency of not less than 99.97 percent. However, the certification shall not be earned by the DOP test specified in FED-STD 209. An acceptable method for certification is to remove a filter from a production run prior to testing, then test the five filters before and after the removed filter in accordance with the DOP test (99.97 percent). Successful passing of the test by the five filters before and five filters after the untested filter shall be the acceptance criteria for the untested filter. Clean filter static pressure drop shall not exceed 1.0 inch wg 250 pascal when the filter is tested at rated capacity.

Filtering element shall contain no holes, cracks, slits, or other visual imperfections. Every splice required in the assembly of a filter pack shall be joined with not less than 1-1/2 inches 40 millimeter of fire-retardant adhesive for a continuous coating along the entire width of the element. Filter element shall be glass paper with a minimum tensile strength of 3 pounds per inch 525 newton per meter of width and shall retain 50 percent of its tensile strength when folded flat upon itself.

Elongation before rupture shall be a minimum of 1 percent. Element shall be water-proofed and shall retain 50 percent of its original tensile strength after being immersed in water.

Results of test penetration, test resistance, test flow rate, together with direction of test airflow, manufacturer's name, model number, and serial number of the filter unit, shall be registered legibly and indelibly on the frame of the filter unit.

Frames shall be 3/4 inch 19 millimeter plywood, Grade A-B EXT-DFPA or better, conforming to NIST PS 1. Plywood shall be treated to exhibit a flame-spread of not more than 30 when tested according to UL 723 or ASTM E 84. Flathead wood screws shall be countersunk after drilling lead holes. Corner joints shall have positive seal by coating adjoining surfaces with a suitable adhesive having the characteristics specified below. Particle board conforming to the flame-spread requirements specified for plywood may be used in lieu of plywood.

Inside face of frame members of materials shall be coated entirely with an adhesive before assembly with filter pack. Following assembly, a continuous bead of the same adhesive shall be formed to seal between cut edges of filter pack and edges of abutting frame member on both faces of the filter unit. Filter unit shall be square to a diagonal tolerance of 1/8 inch 3 millimeter.

Adhesive, when cured, shall be resilient and water-resistant and shall withstand a temperature of 250 degrees F 121 degrees C for 8 hours. If capable of ignition, the adhesive shall be self-extinguishing and shall meet general operating conditions without change in physical properties and without loss of seal. Cured adhesive shall contain no cracks, checks, alligating, or separation.

HEPA filters shall be in accordance with UL 586.

[Frames shall be 14-gage 2.0 millimeter [aluminum sheet] [zinc] [aluminum] [cadmium-coated 16-gage 1.6 millimeter steel sheet]. Corner joints shall be given a positive seal by coating adjoining surfaces with a suitable adhesive having the characteristics indicated.]

Separators shall be constructed of [aluminum] [_____] that will not contribute to fire, will remain structurally intact under fire exposure, and will not be damaged by exposure to the humidity and temperature.

Gasket shall be 1/4 inch 6 millimeter thick closed cellular construction neoprene or approved elastomer of 20 to 40 Shore A durometer hardness. Gasketing shall be attached firmly and continuously to the frame with rubber-based adhesive.

Filter unit shall be assembled to provide uniformity of materials and construction, surface smoothness and finish, cleanliness, and freedom from protrusions and obvious flaws.

2.2 FILTER GAGES AND MANOMETERS

Air-filter gages or manometers shall be provided for each type filter assembly.

Gages shall be the dial-indicator type, graduated to read 0 to 2 inches 0 to 500 pascal wg, except that gages for HEPA filters shall read 0 to 3

inches 0 to 750 pascal wg. Manometers shall measure from minus 0.5 to 3 inches 125 to 750 pascal wg and be equipped with a built-in indicator bubble. Gage or manometer shall be connected to static-pressure ports of approved design and located so that resistance to airflow will be correctly indicated.

PART 3 EXECUTION

3.1 FILTER INSTALLATION

Filter supports and retention elements shall be coordinated to provide a substantial, structurally sound, leakproof installation.

3.2 HOLDING FRAME INSTALLATION

Installation drawings shall be in accordance with referenced standards in this section.

Holding frames shall be gasketed on perimeter, or calked to each other, to supplementary steel, or to closures with elastomeric compounds recommended by the filter manufacturer. Substrate shall be prepared in accordance with the elastomer manufacturer's instructions, including the priming of surfaces in areas where the elastomer is not confined.

3.3 TESTS

Test reports shall be submitted for air filters in accordance with ASHRAE 52.1.

-- End of Section --